

REMARKS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-20 are active in this application, Claim 1 having been amended, and Claims 5-16 and 18-20 having previously been withdrawn. Support for amended Claim 1 can be found, for example, in the original claims, drawings, and specification as originally filed.¹ Applicants respectfully submit that no new matter is added.

In the outstanding Official Action, Claim 1 was rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch et al. (Thermoelectric Properties of Half-Heusler Phases: $\text{ErNi}_{1-x}\text{Cu}_x\text{Sb}$, $\text{YNi}_{1-x}\text{Cu}_x\text{Sb}$ and $\text{Zr}_x\text{Hf}_y\text{Ti}_z\text{NiSn}$, 18th International Conference on Thermoelectrics, 1999, pgs 344-347; hereinafter “Sportouch”) in view of Shen et al. (Synthesis and Sintering of ZrNiSn Thermoelectric Compounds, 21st International Conference on Thermoelectrics, August 25-29, 2002, pgs 166-169, hereinafter “Shen”); Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view of Shen, further in view of Hohl et al. (Efficient dopants for ZrNiSn based thermoelectric materials, J. Phys.: Condens. Matter, 11, 1999, pgs 1697-1709; hereinafter “Hohl”); and Claim 17 was rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view of Shen, further in view of Bell (U.S. Patent No. 6,700,052).

In response the rejection of Claim 1 under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view of Shen, Applicants respectfully submit that amended independent Claim 1 recites novel features clearly not taught nor rendered obvious by the applied references.

Amended independent Claim 1 is directed to a:

...thermoelectric material which is a sintered body and represented by composition formula (1) and comprises as a major phase an MgAgAs crystal structure, the sintered body being obtained by manufacturing an alloy containing

¹ See page 36 of the specification.

predetermined elements, pulverizing the alloy to obtain an alloy powder, and monolithic molding the alloy powder by sintering, hot press or SPS method, wherein the composition formula (1) is $(\text{Ti}_{a1}\text{Zr}_{b1}\text{Hf}_{c1})_x\text{Ni}_y\text{Sn}_{100-x-y}$, and

$a1, b1, c1, x$ and y satisfy the conditions of: $0 < a1 < 1$, $0 < b1 < 1$, $0 < c1 < 1$, $a1+b1+c1=1$, $30 \leq x \leq 35$ and $30 \leq y \leq 35$,

and the sintered body has a dimensionless figure-of-merit ZT value of not less than 0.05 at 300° K.

An advantageous feature of Applicants' Claim 1 is that because a pulverized alloy powder is sintered by a hot press or SPS method, the sintered body has a fine grain size and uniform composition. Thus, the oxygen concentration included in the sintered body as impurities is minimized. Consequently, the thermoelectric characteristics are improved and Applicants' sintered body has a high dimensionless figure-of-merit ZT value of not less than 0.05 at 300° K.

Page 6 of the August 28, 2007 Office Action acknowledged that Sportouch does not teach or suggest a sintered body. In an attempt to cure this deficiency of Sportouch, that Office Action cites Shen. However, Shen fails to teach or suggest that "the sintered body has a dimensionless figure-of-merit ZT value of not less than 0.05 at 300° K," as recited in Applicants' amended independent Claim 1.

Shen describes that

It is known that the sintering of ZrNiSn is companied with the inter-annexing of different grains and so the grains grow up. While in the case of Hf- and Pd-introducing, the growth of the grains would be restrained. That is, at the boundaries between grains, the solid-solution reaction rather than the inter-annexing occurred, and so the grains growth is halted there. As a result, the size of the grains of $\text{Hf}_{0.5}\text{Zr}_{0.5}\text{Ni}_{0.8}\text{Pd}_{0.2}\text{Sn}_{0.99}\text{Sb}_{0.01}$ compound become smaller. It should be pointed out that, fine grain size and homogenous microstructure is benefited *to the reduction in the thermal conductivity and to the improvement of the figure of merit of these compounds.*² (Emphasis added).

² See Shen at page 168.

However, Shen fails to teach or suggest that the sintered body has a dimensionless figure-of-merit ZT value of not less than 0.05 at 300° K. Shen only describes that the sintered body has reduced thermal conductivity and improved figure-of-merit values.

Further, in Shen, a raw material metallic powder is only processed by a solid state reaction and is not melted. In Shen, an alloy is not obtained. In other words, Shen obtains the sintered body from a raw material including a large amount of oxygen. Consequently, the thermoelectric characteristics and dimensionless figure-of-merit ZT value of Shen are adversely affected due to the large amount of oxygen. Whereas, the thermoelectric material recited in Applicants' Claim 1 has a dimensionless figure-of-merit ZT value of not less than 0.05 at 300° K, meaning that it has improved thermoelectric characteristics compared to Shen because Applicants' sintered body contains a smaller amount of oxygen than Shen's sintered body.

Accordingly, Applicants respectfully submit that independent Claim 1 (and all claims depending thereon) patentably distinguishes over Shen and Sportouch.

Accordingly, Applicants respectfully request the rejections of Claim 1 under 35 U.S.C. § 103 be withdrawn.

In response to the rejection of Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Hohl, Applicants note that Claims 2-4 are dependent on independent Claim 1 and are believed to be patentable for at least the reasons discussed above. Further, Applicants respectfully submit that Hohl fails to cure any of the above-noted deficiencies of Shen and Sportouch.

Accordingly, Applicants respectfully request the rejection of Claims 2-4 under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Hohl be withdrawn.

In response to the rejection of Claim 17 under 35 U.S.C. § 103(a) as unpatentable over Sportouch further in view of Bell, Applicants note that Claim 17 is dependent on Claim

1 and is thus believed to be patentable for at least the reasons discussed above. Further, Applicants respectfully submit that Bell fails to cure any of the above-noted deficiencies of Shen and Sportouch.

Accordingly, Applicants respectfully request the rejection of Claim 17 under 35 U.S.C. § 103(a) as unpatentable over Sportouch in view Shen and further in view of Bell be withdrawn.

Consequently, in view of the present amendment, and in light of the above discussion, the pending claims as presented herewith are believed to be in condition for formal allowance, and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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